AMENDED SPECIFICATION

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PATENT SPECIFICATION

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DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Process for preparing a Hard Sweet Dough in a Continuous Operation

We, NATIONAL BISCUIT COMPANY, a corporation organised under the laws of the State of New Jersey, United States of America, of 425 Park Avenue, New York 22, State of New York, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a process for preparing a hard sweet dough in a continuous operation.

The invention is not limited to the baking industry but may readily be applied to other food processing industries. However, the invention is specifically useful with hard sweet doughs which have a high viscosity, in which the amount of diluents, for instance water or milk, is below the usual amount of prior art doughs, and wherein the proportion of sugar is at least 12% by weight.

It has long been recognized that proper mixing of the ingredients prior to the baking stage is essential in practically all baked goods, for the attainment of a homogeneous product having desired characteristics of grain structure, texture, moisture content, flavour and colour.

In the commercial production of baked goods, satisfactory results have been achieved by the use of batch mixing equipment. It is clear, however, that where tons of material are to be mixed at one time, this equipment requires large floor space, is expensive in initial cost, and has high power requirement and high maintenance and replacement cost.

The continuous system on the other hand has a very high capacity relative to the size of the mixing unit, because it operates on smaller volumes than batch systems at any one time so that lower horsepower installations are permissible. Batch mixing operation is more suitable where it is not possible to measure the amount of each ingredient carefully and where differences in composition of flour may give rise to unforeseen changes in consistency during mixing, because each batch may be processed for a different length of time or adapted during operation to different conditions. It is safe to conclude that whenever possible, cost-minded manufacturers have shifted to continuous processes because the machines are smaller, may be built throughout of the more expensive corrosion-resistant material, and because of more effective use of the power.

In recent years some successful results have been claimed with continuous processes for mixing doughs, batters and even bread doughs.

No serious difficulties have been encountered in the conversion from a batch to a continuous process, where simple blending of thin liquids and dry powders is involved or where the diluent is present at least to the extent of 35% of the dough, and continuous mixing of the ingredients has been feasible. Continuous mixing is also possible where a high proportion of water is continuously added to the flour, and in addition, gas is injected such as air or car-

bon dioxide, so that the mixture of ingredients is maintained sufficiently thin during mixing.

However, known processes and equipment are not successful with hard-sweet doughs, because the dough is far more viscous than the usual batter, and contains no more than 12% of water, and as low as 6.5%, based on the total dough composition, not including water present in flour and other ingredients.

Whatever is the situation with sponge and bread dough, no progress had been disclosed prior to the present invention in the art of continuous mixing hard sweet doughs, that is hard doughs of high viscosity. Here, mixing even on a batch scale is a problem, and the manufacture has been concerned with devising equipment at least suitable for batch operations. With attention centred in devising equipment suitable for each individual specific process, on a batch scale, little or no theory was available, prior to this invention, which might have led to any quantitative and systematized approach to the mixing on a continuous scale. Continuous mixing of hard sweet doughs was considered out of reach by the man in the art.

Admittedly some manufacturers have marketed and advertised equipment for continuously mixing hard-to-mix materials, and thermoplastic solids. These devices called masticators or continuous kneaders or extruders, are claimed to be successful with several types of hard materials. However, in our experience with hard sweet doughs, they proved far from satisfactory. Some experiments were conducted by using a combination of gravimetric and volumetric-type feeders. Flour, soda, ammonium bicarbonate were blended and discharged into the mixing zone. Other dry ingredients, namely, sugar, cocoa, egg powder, were blended and fed into the premixing zone. Liquid ingredients, lard, water, eggs, corn syrup, stored in individual holding tanks, were pumped into the premixing zone and then the mass discharged into the mixing zone. A combination of helical screws and angularly positioned paddle blades rotating at about 70 r.p.m., worked and moved the resulting mass. The time of mixing from the inlet end of the mixing zone to the discharge end was 2.5 minutes, with a rate of 3000 pounds per hour. The resulting doughs were soft and sticky suggesting that kneading was inadequate, and that hydration of the dry solids was not homogeneous. It was found to be advantageous to use a second kneader, to give additional "working" and mixing of the dough. Under these conditions, sufficiently uniform hydration and sufficient "body" was achieved so that a lay time of 15 to 30 minutes was adequate, before the next steps, cutting and baking.

A major difficulty, however, was that after a short period of operation the dough temperature began to rise due to mechanical heat development. Refrigeration was essential, necessitating a 15 HP, 15 ton per day capacity, circulating refrigeration system. For more efficient refrigeration, two air-cooled 1½ HP, refrigerant circulating units had to be installed. On occasions, during hot weather, a third 1½ HP refrigerating unit was used.

Although this process was significant as a first attempt in the continuous manufacture of hard sweet doughs, it is obvious that, as a whole, it was far from satisfactory. The cost involved in the refrigeration was substantial, it still needed a lay-time, and in any event the process could not be run on a truly continuous scale, but could only be run for short periods of time and required just as much attention as any batch process.

It has now been found that it is possible to prepare the hard sweet dough by a continuous process and to supply a continuous stream of uniformly blended and kneaded dough to the oven without interruption and without undue development of heat. Thus the present invention represents a revolutionary advance in an art, that is, manufacture of hard sweet dough, where continuous mixing was considered an impossibility.

One object of the present invention is to provide for the continuous manufacture of hard sweet dough in a satisfactory and practical manner so as to deliver to the oven a continuous stream of fully mixed dough, without the disadvantages and deficiencies which have interfered with the continuous preparation of hard sweet dough mixes.

It is an advantage of the present invention that it provides a process whereby a hard sweet dough may be produced uniformly, in reproducible manner with fewer steps, and less labor than heretofore in the baking industry.

Other advantages achieved by the invention are reduced cost, less equipment, less space for the equipment and less attention than is required by the common batch operations.

Moreover improved finished products with easily reproducible qualities of texture, flavour and appearance, result from the new process.

Another advantages is seen in the fact that the new process insures the feed or discharge of accurately predetermined amounts of the materials throughout each period of the operation; it also provides for continuously weighing and recording the weight of the material which has been discharged.

The dry and wet ingredients, moreover, blend thoroughly before any kneading and shearing action is applied.

The lay-time is also avoided which in addition to delaying the operation, causes changes in the consistency of the dough if samples are compared at different intervals of time after the beginning of the operation.

According to the invention there is provided a process for preparing a hard sweet dough in a continuous operation from ingredients comprising dry components including sugar

and flour, shortening, water soluble components and water, comprising the steps of simultaneously but separately premixing said dry components with each other in a dry mixer (first mixer), separately metering said shortening, separately preparing a slurry from said water soluble components and water, then continuously supplying the premixed dry components, the metered shortening components, and the slurry into a high speed blender (second mixer) which thoroughly blends all components to form a blend containing by weight 6.5 to 12% of water, 12 to 21% of sugar and 8 to 15% of shortening and then continuously feeding the blend into a slow speed kneading zone (third mixer) wherein the blend is kneaded for a time sufficient to convert the blend to a uniformly hydrated hard sweet dough, the mixing element of said high speed blender turning at a greater rate than the rotating element of said third mixer.

For the sake of clarity, "dough", means a mixture of flour and water and usually other optional ingredients, thick enough to knead or roll. The term "hard sweet dough" comprises generally all the formulations of flour, sugar, water, and/or milk and a shortening, as the essential ingredients, with a chemical as a leavening agent. Some optional ingredients may be present, depending on the formulation, for instance colouring or flavouring agent, cocoa, eggs, and the like.

The consistency of hard sweet dough is far higher than in ordinary batters, and other doughs. By way of comparison, bread dough has a specific gravity less than 1, in the order of 0.6. On the other hand, the hard sweet doughs within the scope of this invention, have a specific gravity over 1, usually between 1.1 and 1.5 before the goods enter the oven.

The term "flour" is used here with reference to wheat flour, potato flour, corn flour, and rye flour in whole or in part. The flour used in the preparation of the hard sweet dough may have a variable protein content between 7 and 11% of protein, although it is usually preferred to use "weak" flour, that is, containing between 7 and 9.5% of protein, in the preparation of sweet doughs. As a sweetening agent, cane sugar of different grade is used according to each individual formulation. Dextrose, commercially known as corn sugar, may also be used. Other types of sweetening agents, available in solution or syrup form, for instance invert syrup, levulose, honey, corn syrup, malt syrup, may, if the specific formulation calls for, be added to the aqueous slurry.

Where optional ingredients are used, they should be blended with either the shortening phase or the dry material phase or the slurry. For instance, if an emulsifier and "chocolate liquor" are used, they are preferably added to the shortening. As an emulsifier, lecithin or lactylated monopalmitin may be used. Optional water-soluble ingredients, such as flavouring agents, are easily dissolved in the slurry.

The term "chocolate liquor" mentioned above can be explained as follows:—

The manufacturer of chocolate products cleans the cocoa beans, roasts them and removes the hull and germ. The resulting pieces are called nibs. When the nibs are ground, chocolate liquor or bitter chocolate results. Chocolate liquor is the basic material from which all chocolate products are made. It is composed of 50 to 52% cocoa butter and 48 to 50% cocoa solvents (fat-free).

An essential feature of the invention is the combination of the water-soluble ingredients in the aqueous slurry. It has been found that the flavour and colour of the baked products are improved when invert syrup and a milk product are dissolved in water in the presence of an alkaline reagent, usually the soda used as the leavening agent. It is believed that this effect is the result of a chemical reaction between the reducing sugar and the protein of milk, commonly known as the Maillard reaction.

The process of the invention has been thoroughly tested, and at no time the temperature of the material emerging from the mixing zone, where the material is kneaded, is above 106°F. Generally the temperature is lower than 106°F., that is in the range of 90°F. to 96°F., and the temperature in the first and second mixing zone never rises above 85°F. The temperature rise in the third mixing zone, where the dough is kneaded, may be controlled, if the sequence of steps is properly controlled as described herein. This temperature range, between 90° and 106°F., is very suitable for the next operation, namely the cutting and stamping step.

For a better understanding of the invention, reference may be had to the accompanying flow sheet which gives a schematic picture of the process. The dry goods, flour, sugar, and any optional materials, for instance cocoa, are stored in tanks (not shown) so as to maintain a steady supply. From the tanks each material is fed to the bins. Cocoa is one of the optional ingredients shown in the flow sheet under "other ingredients". By "cocoa" is meant the product from the cocoa bean after cleaning, roasting and removing the hull and germ. The cocoa may be either Dutch cocoa, which is made by treating the beans during manufacture with strong caustic potash, or American cocoa or preferably, a mixture of the two, because the flavour of very light-coloured untreated American cocoa is almost lost in biscuits and cookies.

It is essential to the success of the operation that the amounts of each ingredient be accurately weighed on a continuous basis, rather than measured volumetrically as used heretofore for continuous operations. Accurate control of the amounts of each solid ingredient at this stage permits more reproducible results

and has been one of the essential factors in eliminating non-uniformity and the temperature rise in the final mixing and kneading zone which, prior to the present invention, had made continuous operation impractical.

Merchen feeders continuously discharging from the bins accurately weighed amounts of each solid are very satisfactory, but any metering or scale device capable of being interposed between the bins and the vessel where the solid ingredients are combined and mixed, is satisfactory as long as it provides for accurate weighing and is adaptable to a continuous operation.

The solid components are accurately measured, then led into a hopper (not shown) and then to the first mixing zone, shown in the flow sheet as Mixer No. 1, where they are thoroughly blended. It has been found essential for the smooth operation of the process to provide a mixer with high-speed-revolving shaft so that adequate blending is achieved in the period between 1 and 30 seconds. An apparatus with a shaft provided with adjustable blades, revolving at a rate between 350 and 1000 r.p.m. is satisfactory, and the temperature usually remains below 85°F.

Any device for conveying material may be used from the tanks to the bins, and from the bins to the mixer, for instance, screw conveyors, belts, rotary feeders, provided with a controllable gate or valve. It has been found particularly advantageous to use vibrators, after the material has been weighed because they provide for complete discharge with no hold up. The dry blended materials are then led to the second mixing zone, shown in the flow sheet as Mixer No. 2.

As a shortening, all-hydrogenated lard or butter may be used as well as vegetable oils, oleo oils, coconut and palm oils. Incompletely hydrogenated lard or cottonseed, corn and peanut oil may also be used in different formulations. From a flavour standpoint and where long stability is not of the essence, butter is excellent as a part of the shortening in many sweet doughs.

Very satisfactory results are achieved with lard, but it is to be understood that the selection of the shortening or butter or a combination of both is not a limitation on the process, but depends upon each individual formulation. In some instances, the "hard butters" of commerce may be substituted in whole or in part. The term "hard butter" indicates the products of interesterification and rearrangement of natural fats or mixtures of same which is believed to cause a "random" distribution of the fatty acid radicals in the triglyceride units. If the shortening or hard butter used is in the solid phase, at room temperature, provision is made (not shown) to provide moderate heat sufficient to melt the solid. Also the shortening is continuously weighed and led into the second mixing zone, by means of a metering pump.

The third phase, that is, the aqueous phase or, as it is more usually called, "the slurry", contains water, a leavening agent, salt and may contain also milk or a milk substitute, invert syrup, levulose, according to the specific formulation, and eggs, or egg powder. All these ingredients are carefully measured and dissolved or suspended in water in the slurry mixing tank. A metering pump M.P. accurately measures the rate of discharge of the slurry to the second mixing zone.

Leavening agent is the term used in the art to indicate a source of gas which causes a dough or batter to spring, giving a porous, open structure to the product. Very satisfactory results have been obtained with sodium bicarbonate, alone, since it decomposes during baking to give the desired carbon dioxide.

It is preferred to have all the elements of the apparatus subject to remote controls, to permit the operator to follow and regulate the course of the mixing. The table below gives variations in specific formulations of hard sweet doughs, classified according to the sugar content and based on the ratio of each ingredient to flour. Thus the table shows a "Low-Sugar", a "Medium-Sugar" and a "High-Sugar" content formulation. It is to be understood, however, that the three formulations are given by way of illustration, and that broadly the hard sweet doughs may contain only the three basic components, flour, sugar and a diluent, which is a shortening and water. Thus the term hard sweet doughs broadly comprises formulations containing between 12 and 21% of sugar, between 6.5 and 12% of added water, and between 8 and 15% of shortening, these percentages being expressed with reference to the total dough composition.

Referring now to the three formulations shown in the table, variations are possible not only from one formulation to the other, but by the omission or addition of some ingredients. For instance, the use of an emulsifer, which is another optional ingredient, has not been shown in the three formulations in the table. As indicated above, the amount of water, between 6.5 and 12%, is the added water, and does not include water present, for instance, in flour and other ingredients.

	Low Sugar		Medium Sugar		High Sugar	
	lbs.	No. of lbs. per hr.	lbs.	No. of lbs. per hr.	lbs.	No. of lbs. per hr.
Dry Materials:						
Flour	100	2000	100	2000	100	2000
Sugar	21	420	33	660	47	940
Cocoa					20	400
Shortening:	25	500	16.5	330	18.5	370
Slurry:						
Liq. Sugar	3	60	3	60	9	180
Eggs	3	60	3	60		
Milk	1.25	25	1.25	25	2.5	50
Salt	1	20	1	20	1.25	25
Leavening	1	20	1	20	3	60
Flavor	0.06	1.2	0.25	5	1.5	30
Water	12	240	13	260	25	500
Total Slurry	21.31	426.2	22.50	450	42.25	845
Total Weight	167.31	3346.2	172.0	3440	227.75	4555

It is seen from the table that the amount of flour is kept constant in each formulation and the amount of the other ingredients varied. Although in the table, the High-Sugar formulation shows that cocoa is used where a chocolate flavour is desired, it may be possible at least partially to replace the cocoa with chocolate liquor. In this case if the cocoa is cut down to one-half, that is, 10 pounds of cocoa instead of 20 pounds, the amount of chocolate liquor is 3 to 5 pounds per 100 pounds of flour. In other words, the chocolate liquor is added at a rate of 1 to 1.8 pounds per minute.

For the successful operation of the process, the adjustment of the feeding devices of all ingredients, the rate of discharge from each mixing zone, and rate of discharge at the outlet of the third mixing zone, must be carefully controlled for each formulation. By way of illustration, and with reference to the three formulations shown in the table, the rate of feeding flour is kept constant, namely 33.33 pounds per minute, equivalent to 2000 pounds per hour. Flour may be partly supplemented with meal, that is recovered material from prior preparations, usually material rejected because broken into small pieces. Also different grades of flour or types of flour may be required, according to specific formulations. With a flour feed at the rate of 33.33 pounds per minute, the sugar rate must be adjusted to 7 pounds per minute in the low-sugar formulation, 11 pounds per minute in the medium-sugar formulation and 15.66 pounds per minute in the high-sugar formulation. When cocoa is added, as in the high-sugar formulation, the rate of feeding is 6.6 pounds per minute.

The rate of feeding of each ingredient for the three formulations shown in the table is obviously easily derived by dividing the total number of pounds of each ingredient per hour by 60. For instance the total number of pounds of aqueous slurry added per minute for each formulation is obtained by dividing the total number of pounds of aqueous slurry per hour by 60. Thus, by way of example, the rate of addition of shortening for the Low-Sugar formulation is 500/60, that is 8.3 pounds per minute, and for the Medium-Sugar formulation is 330/60 or 5.5 pounds per minute, and for the High-Sugar formulation is 370/60 or 6.1 pounds per minute.

Similarly for the total aqueous slurry, the total amount fed per minute is 426.2/60, that is, 7.1 pounds per minute for the Low-Sugar formulation, 450/60, that is 7.5 pounds per

minute for the Medium-Sugar formulation and 845/60, that is, 14.08 pounds per minute in the High-Sugar formulation.

The amount of salt in the low and medium sugar formulation is 0.33 pounds per minute, and 0.41 pounds per minute in the high-sugar formulation. The amount of milk is preferably 0.41 pounds per minute in the low and medium sugar formulation and 0.83 pound per minute in the high-sugar formulation. Invert syrup and malt extract, schematically represented in the diagram as liquid sugar, are fed into the aqueous phase at a rate 1 pound per minute in the low and medium sugar formulation, and 3 pounds per minute in the high-sugar formulation.

The amount of water is pumped at a rate of 4 pounds per minute in the low-sugar formulation, 4.3 pounds per minute in the medium-sugar formulation and 8.3 pounds per minute in the high-sugar formulation.

The amount of flavouring agents varies from 0.02 pound per minute in the low-sugar formulation to 0.08 pound in the medium-sugar formulation to 0.5 pound in the high-sugar formulation.

The amount of leavening agent, usually sodium bicarbonate, varies between 0.33 and 1 pound per minute.

With the rate of feeding flour kept at 33.33 pounds per minute, the rate of discharge of dry solids from Mixer No. 1 in the low-sugar formulation is 40 lbs. per minute, in the medium-sugar formulation 44 lbs. per minute and in the high-sugar formulation 55.7 lbs. per minute.

As the flow sheet indicates, the dry solid phase, the liquid slurry and the shortening phase are continuously fed into the second mixing zone, namely Mixer No. 2.

Here it is essential that good blending of the dry ingredients, slurry and shortening, be achieved with a residence time between 1 and 30 seconds. This may be achieved with an apparatus in which the rotatable shaft or other mixing element revolves at a rate between 350 and 1000 r.p.m. preferably 720 r.p.m. If the conditions are carefully controlled, the temperature in the second mixing zone never rises above 85°F. The invention is not limited to the use of any particular mixing apparatus, as long as good blending of dry ingredients, liquid ingredients and shortening is achieved in the same period of time, that is, 1 to 30 seconds.

From the second mixing zone, the material is led to the third mixing zone, shown as Mixer No. 3 where efficient mixing and kneading occurs. By way of illustration and with reference to the three formulations given in the table, the rate of discharge from the second mixer in the low-sugar formulation is 55.76 pounds per minute, 57.43 pounds per minute in the medium-sugar formulation, and 75.91 pounds per minute in the high-sugar formulation.

In the third zone, which is shown in the flow sheet as Mixer No. 3, all the materials must react with water to give uniform hydration, which is essential for the achievement of a homogenous dough.

It has now been found that homogeneity of the dough and uniform hydration may be achieved in the kneading zone with a residence time between 30 seconds and 3 minutes.

One type of apparatus used successfully in this kneading step is a slow speed mixer-extruder with shaft preferably adjusted at 40 r.p.m., although the rate of revolution may be adjusted within the range of 30 to 90 r.p.m.

Although the invention is not limited to the use of any specific make of extruder or type of shaft, very satisfactory results were obtained with a mixer-extruder having a cylindrical housing and being provided with a rotatable shaft and cut-off blades on the shaft to mull and slice the material.

In order to provide additional kneading action, at least one and preferably two screens are positioned in the interior of the extruder, affixed to the inner walls of the housing. It was also found advantageous to attach to the inner walls of the apparatus at least a pair and preferably four plow blades disposed at diametrically opposite points in the inner part of the cylinder. These plow blades, inserted between the rotating blades, act as stationary anvils, and greatly contribute to kneading and fully developing the dough. The material is fed into the housing at one end, forced forward by the rotating blade on to the anvil. As the blade passes the anvil, a portion of the material is pushed forward and the remainder stays behind subject to repeated kneading action. The extrusion head is provided with a nose cone which gives additional blending and kneading action, thus insuring the production of smooth, properly kneaded, uniformly hydrated material.

It is significant that by the proper combination of steps, as described herein, it has been found unnecessary to cool by external refrigeration in any of the mixing or kneading steps, namely the first or second mixing zones as well as the extruder. The temperature at no time rises above 106°F., and is usually below 96°F. The severe kneading treatment carried out in the third zone, that is the mixer-extruder, converts the preliminary blend to a putty-like homogeneous non-sticky dough, well kneaded, of uniform hydration throughout. From the mixer-extruder, the material advances at a predetermined rate towards the cutting and the stamping zone, and then to the oven. The rate of discharge, by way of illustration, is 55.76 pounds per minute in the low-sugar formulation, 57.43 pounds per minute in the medium-sugar formulation, and 75.91 pounds per minute in the high-sugar formulation.

For the purpose of better illustrating the

invention, the following examples are described in detail.

EXAMPLE 1

A blend of wheat flour (protein content 8.5%) and sugar was continuously prepared by passing flour at the rate of 2000 lbs. per hour, corresponding to 33.33 pounds per minute and sugar at the rate of 7 pounds per minute in the first Mixer, with a residence time of 10 seconds, and rotation of the shaft set at 650 r.p.m.

Lard was fed to the second Mixer at a rate of 8.3 pounds per minute.

The aqueous slurry was separately prepared on a batch scale, although it may also be prepared on a continuous operation. On a batch scale, the materials sufficient for a 4 hour run were mixed, namely 960 pounds of water, 80 pounds of salt, 240 pounds of egg powder, 100 pounds of milk, 80 pounds of leavening agent, 4.8 pounds of vanilla and 240 pounds of invert syrup. The aqueous slurry, thus prepared, was fed to the second mixer at a rate of 7.1 pounds per minute.

The dry material blend was discharged from the first mixer at a rate of 40 pounds per minute. A satisfactory blending of the three phases, shortening, dry materials and aqueous slurry was achieved in the second mixer with a residence time of 10 seconds, and shaft rotating at 720 r.p.m.

This blend was removed from the second mixer at the rate of 55.76 pounds per minute, and passed to the mixer-extruder (mixer 3), where the residence time was 2 minutes. The temperature in the extruder remained throughout the operation at 95°—100°F. The material was removed from the third mixed extruder at the rate of 55.76 pounds per minute. It was then subjected to a cutting device, and baked. The resulting goods after 120 hours of the continuous operation were of excellent quality, tender and homogeneous. The output was 3346 lbs. per hour.

EXAMPLE 2

Flour (of protein content 9.5%), at the rate of 33.33 pounds per minute and sugar at the rate of 11 pounds per minute, were mixed in the first mixer where the residence time was 30 seconds. The shaft was rotated at a speed of 650 r.p.m. The rate of discharge of the dry solids to the mixer was 44 pounds per minute. Shortening, namely lard, was discharged into the mixer at a rate of 5.5 pounds per minute.

The aqueous slurry was prepared by combining 1040 pounds of water, 100 pounds of milk, 80 pounds of salt, 80 pounds of leavening, 20 pounds of vanilla, 240 pounds of liquid sugar, 240 pounds of egg powder, that is the ingredients required for a 4 hour operation. The aqueous slurry was discharged into the mixer at a rate of 5.5 pounds per minute. The residence time in the second mixer was 15 seconds, and in the third mixer extruder it was 2.5 minutes. The temperature in the Reitz extruder did not exceed 95°F., and remained mostly between 90° and 92°F., throughout the operation of 90 hours.

After cutting and baking, the goods were crispy, light, homogeneous in flavour, appearance and weight. There was no change in the quality of the finished goods at the end of the operation, which gave an output of 3440 pounds per hour.

EXAMPLE 3

Flour at a rate of 33.33 pounds per minute and sugar at the rate of 15.66 pounds per minute were continuously fed into the first mixing zone. Cocoa was sieved, cooled to below 70°F. and fed to the same first Mixer at a rate of 6.6 pounds per minute. With a residence time of 15 seconds and with a shaft rotating at 690 r.p.m., a good premixing of the three dry ingredients was achieved. The dry solids were fed into the second mixer at a rate of 55.6 pounds per minute.

Lard was fed into the second mixer at a rate of 6.1 pounds per minute. The aqueous slurry was prepared in a batch for a 4 hour operation, namely 2000 pounds of water, 720 pounds of invert syrup, 200 pounds of milk powder, 100 pounds of salt, 240 pounds of leavening, 120 pounds of vanilla. In the second mixer, the dry solids, the slurry and shortening were blended with a residence time of 20 seconds and fed into the extruder at a rate of 75.91 pounds per minute. The residence time in the extruder was 1.5 minutes, with a shaft rotating at 46 r.p.m. The rate of extrusion from the extruder was 75.91 pounds per minute. The mixing was continued for 70 hours. with an output of 4555 pounds per hour, giving a very satisfactory homogeneous dough.

Although not shown in the table nor in the diagram, an edible emulsifier may be added either to the shortening or to the aqueous slurry, in amount of 1 to 4 ounces per 100 pounds of flour. As edible emulsifier, lecithin or glyceryl lacto palmitate may be used.

As a further proof of the function of each step of the process in accordance with the instant invention, and particularly the function of Mixer No. 2 and the function of Mixer No. 3, moisture content determinations have been performed with the Low-Sugar, Medium-Sugar and High-Sugar formulations. The moisture content determinations were conducted by the toluene test, by removing samples of dough at the outlet of Mixer No. 2 and also Mixer No. 3. The samples were removed at uniform time intervals, as well as several samples were simultaneously removed from the same zone. The moisture content was the same, within the limit of experimental error, thus indicating that blending of water with the other ingredients is achieved in Mixer No. 2, and that the Mixer No. 3 does not contribute to the uniform distrubtion of the water, and other ingredients. On the other hand, the dough at the outlet of Mixer No. 2

has the appearance and texture of coffee ground, that is, although well blended, has no body. As it leaves Mixer No. 3, the dough has putty-like appearance and is well kneaded, indicating that the function of Mixer No. 3 is to cause uinform hydration of the dough.

From the foregoing, it may be seen that this invention constitutes a substantial advance in the art of mixing hard sweet doughs, because it makes possible the continuous mixing of hard sweet dough, in an economic, homogeneous and reproducible fashion. The doughs prepared according to this instant invention, are not only a mass of well blended ingredients, but the dough has been kneaded to achieve uniformly the desired degree of hydration, which is necessary for full development of doughs prior to cutting, stamping and backing.

WHAT WE CLAIM IS:—

1. A process for preparing a hard sweet dough, in a continuous operation from ingredients comprising dry components including sugar and flour, shortening, water soluble components and water, comprising the steps of simultaneously but separately premixing said dry components with each other in a dry mixer (first mixer), separately metering said shortening, separately preparing a slurry from said water soluble components and water, then continuously supplying the premixed dry components, the metered shortening components, and the slurry into a high speed blender (second mixer), which thoroughly blends all components to form a blend containing by weight 6.5 to 12% of water, 12 to 21% of sugar and 8 to 15% of shortening and then continuously feeding the blend into a slow speed kneading zone (third mixer) where the blend is kneaded for a time sufficient to convert the blend to a uniformly hydrated hard sweet dough, the mixing element of said high speed blender turning at a greater rate than the rotating element of said third mixer.

2. The process according to claim 1, wherein said dry components are mixed in said dry mixer for one to thirty seconds, wherein the mixing in the high speed blender (second mixer is achieved during a further mixing time of between 1 and 30 seconds, and then continuously discharging the blend to said kneading zone (third mixer) wherein a uniformly hydrated dough is obtained during a kneading time of between 30 seconds and 3 minutes in said kneading zone.

3. The process according to claim 1 or 2, wherein the temperature in the dry mixer and in the high speed blender (second mixer) is 85°F. or lower.

4. The process according to claim 1, 2 or 3, wherein the temperature in said kneading zone (third mixer) is between 90° and 106°F.

5. The process according to any one of claims 1 to 4, wherein each of said ingredients is continuously weighed.

6. The process according to any one of claims 1 to 5, wherein the dry mixer (first mixer) is adapted to receive a plurality of dry solid components, such as cocoa, meal, corn flour, potato flour and rye flour, each of said dry components being discharged at a predetermined rate into the first mixer simultaneously with the sugar and flour such as wheat flour.

7. The process according to any one of claims 1 to 6, wherein a leavening agent is added to said slurry.

8. The process according to any one of claims 1 to 7, wherein an edible emulsifier is added to the shortening.

9. The process according to claim 8, wherein the emulsifier is lecithin, added in an amount of 1 to 4 ounces per 100 pounds of flour.

10. The process according to any one of claims 1 to 9 for preparing said hard sweet dough comprising the steps of continuously feeding into the dry mixer (first mixer) flour at a rate of 33.33 pounds per minute, sugar at a rate between 7 to 16 pounds per minute cocoa at a rate between 0 to 6.6 pounds per minute, to form a blend, and discharging the blend at a rate of 40 to 55.7 pounds per minute into the high speed blender (second mixer), feeding into the second mixer shortening at a rate of 5 to 9 pounds per minute and a slurry which is continuously prepared from water at a rate of between 4 to 8 pounds per minute from invert syrup between 1 to 3 pounds per minute, milk between 0.4 to 0.8 pounds per minute, salt between 0.3 to 0.4 pounds per minute, a leavening agent between 0.3 to 1 pound per minute, and a flavouring agent between .02 and .5 pounds per minute, forming a blend of said slurry, said shortening and said dry ingredients in the high speed blender (second mixer), and discharging the blend at a rate of 55 to 76 pounds per minute into the kneading zone (third mixer) from which the dough is discharged at a rate of 55 to 76 pounds per minute.

11. The process according to any one of claims 1 to 10, wherein the dough has a specific gravity between 1.1 to 1.5.

12. The process according to any one of claims 1 to 11, wherein chocolate liquor is added to said shortening prior to discharge into the high speed blender (second mixer), in an amount of 3 to 5 pounds per 100 pounds of flour.

13. The process according to any one of claims 1 to 12, wherein a mixing element in the dry mixer (first mixer) and said mixing element in the high speed blender (second mixer) rotate at a speed of between 350 to 1000 r.p.m., while the rotating element in the kneading zone (third mixer) rotates at a speed of between 30 and 90 r.p.m.

14. A process according to claim 1 for preparing a hard, sweet dough substantially as described.

15. A cooked product prepared from the hard, sweet dough when prepared according to any one of claims 1 to 14.

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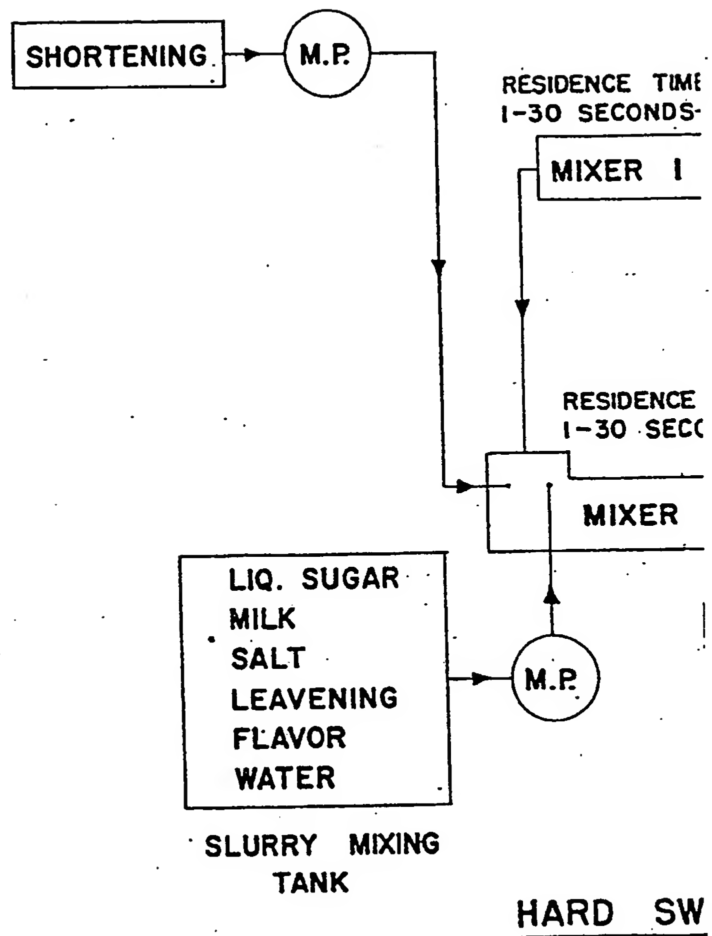
SHORTENING
M.P.
RESIDENCE TIME
1-30 SECONDS
MIXER I
RESIDENCE
1-30 SEC
MIXER
LIQ. SUGAR
MILK
SALT
LEAVENING
FLAVOR
WATER
M.P.
SLURRY MIXING TANK
HARD SW

1044554 AMENDED SPECIFICATION
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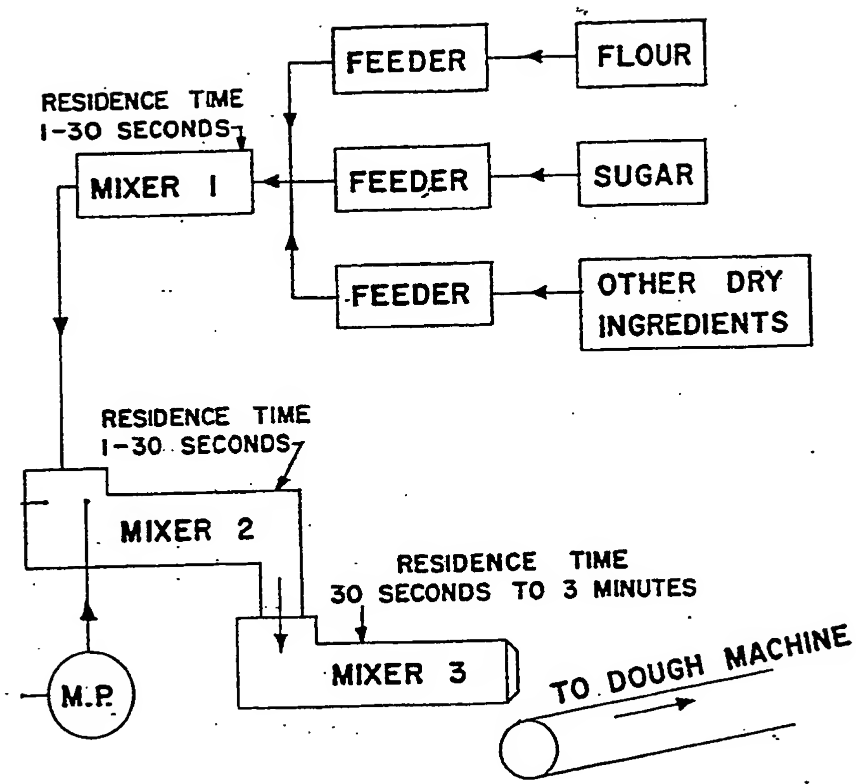

HARD SWEET GOODS

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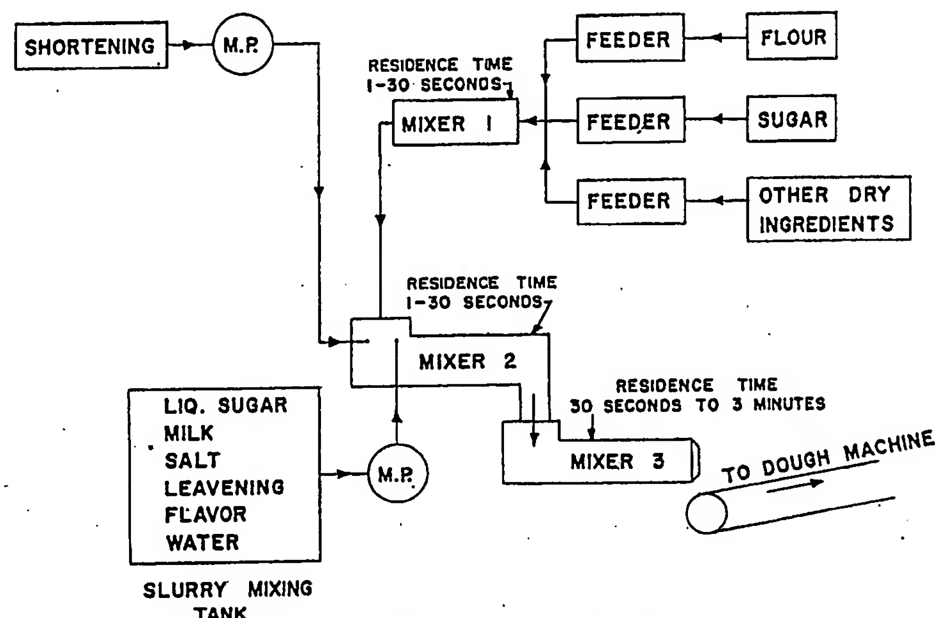

HARD SWEET GOODS